

University of Bahrain
College of Information technology
Department of Computer Engineering

Test (2)

Student Name
I.D. No.
Section

Course Title: Digital Logic

Course number: ITCE 250

Semester: 1

Academic Year: 2015/2016

Duration : 1 hour

Date: 9th December 2015

Read the following before you start:

1. Write your name, ID and section number
2. Answer all questions.
3. Write your answers on the attached sheets only

4. **Use PEN only**

4- Use PEN only

Question	Mark	Mark attained
1	16	16
2	16	16
3	16	16
4	16	16
5	16	16
Total	80	80

Question [1]: [16 mark]

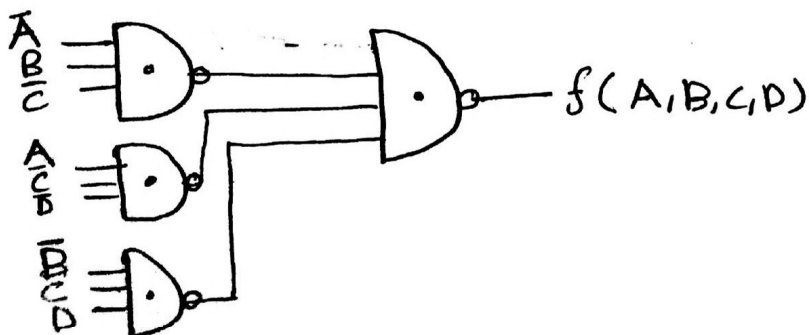
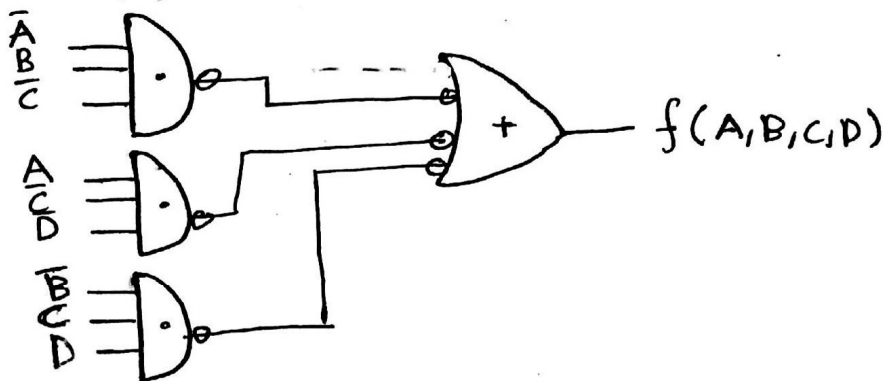
Realize the following function as a minimum two-level NAND gate circuit.

$$f(A, B, C, D) = \prod M(0, 1, 7, 9, 10, 13) \cdot \prod D(2, 6, 14, 15)$$

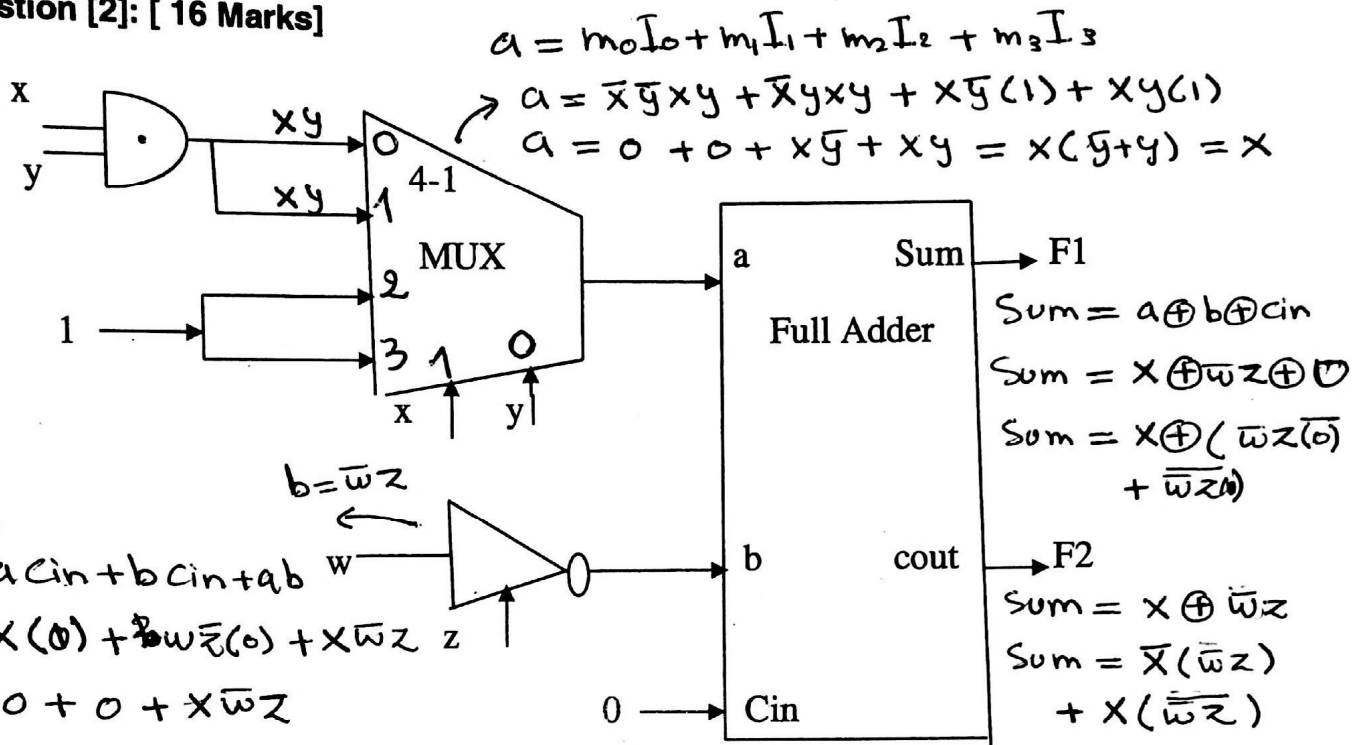
$f(A, B, C, D) = \sum m(3, 4, 5, 8, 11, 12) + \sum d(2, 6, 14, 15)$

		$\overline{A}B\overline{C}$				
	AB	00	01	11	10	
CD	00	0	1	1	1	$A\overline{C}\overline{D}$
	01	0	1	0	0	
	11	1	0	X	1	$\overline{B}CD$
	10	X	X	X	0	

$$f = \overline{A}B\overline{C} + A\overline{C}\overline{D} + \overline{B}CD$$



Question [2]: [16 Marks]



1- Derive the truth table and output equations of a Full-Adder.

2- Write the input equations of the given F-A.

3- Write the output equations of the given F-A as Sum of Products.

1)

a	b	cin	Cout	Sum
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

Cout

a	0	1
b cin	0 0	0 0
0 1	0	1
1 0	1	1
1 1	0	1

$$Cout = aCin + ab + bCin$$

Sum

a	0	1
b cin	0 1	1 0
0 1	0	1
1 0	1	0

← no simplification

$$\begin{aligned}
 Sum &= \bar{a}\bar{b}cin + \bar{a}b\bar{c}in + a\bar{b}\bar{c}in + abcin \\
 &= \bar{a}(b\bar{c}in + b\bar{c}in) + a(\bar{b}cin + bcin) \\
 &= \bar{a}(b \oplus cin) + a(\bar{b} \oplus cin) \\
 &= a \oplus (b \oplus cin) = a \oplus b \oplus cin
 \end{aligned}$$

2) $a = x$, $b = \bar{w}z$, $Cin = 0$

3) $F_1 = \bar{x}\bar{w}z + x(w + \bar{z}) = \bar{x}\bar{w}z + xw + x\bar{z}$

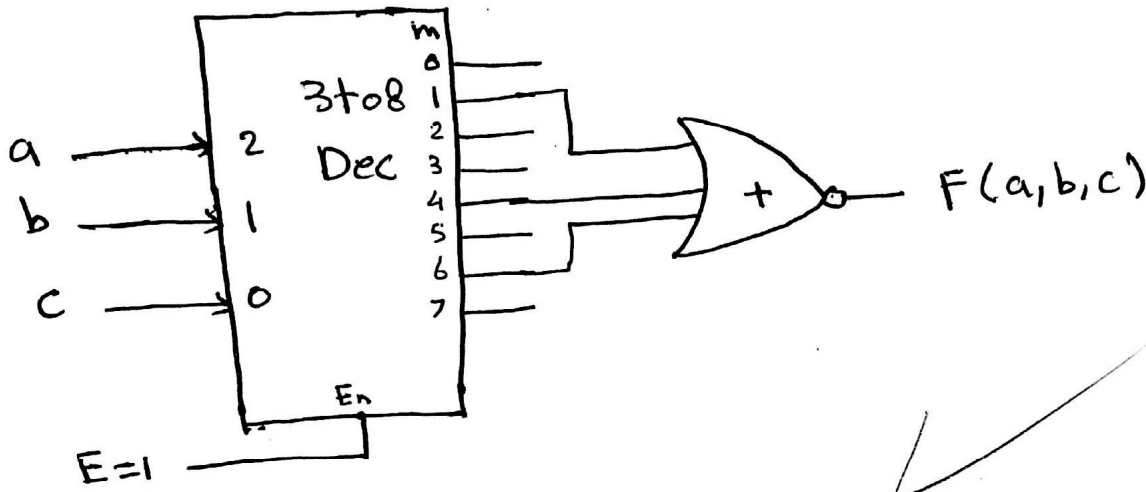
$F_2 = x\bar{w}z$

Question [3] : [16 marks]

- a- Implement the function F with a 3-to-8 active high decoder and NOR extra gate.

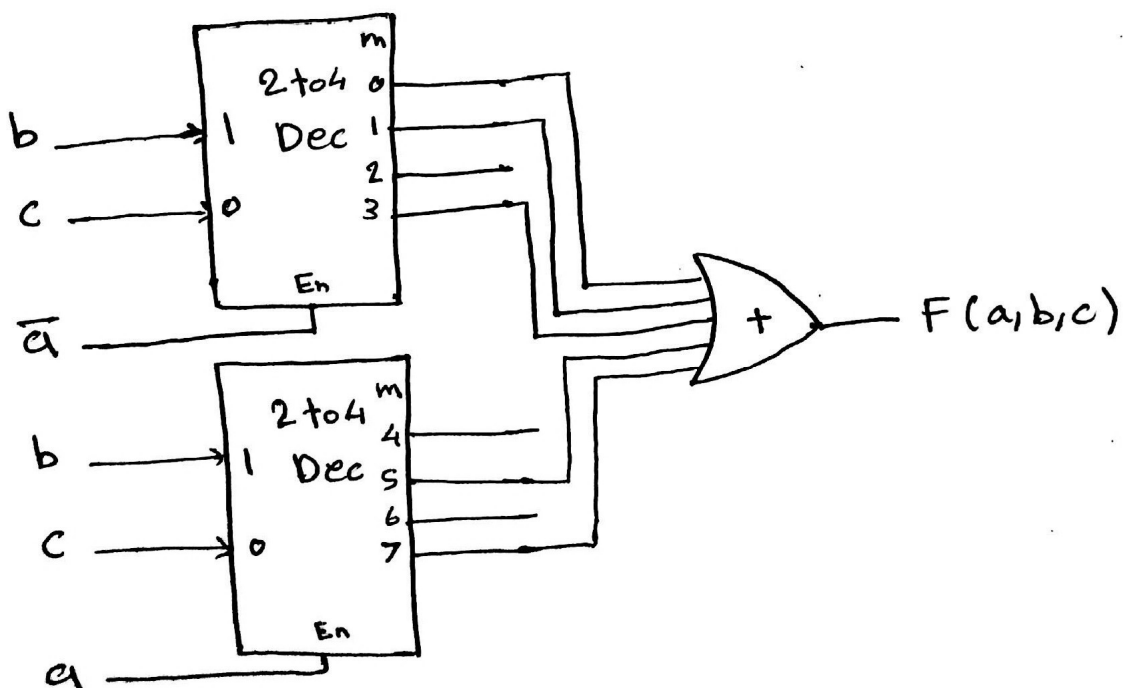
$$F(a,b,c) = \sum m(0,2,3,5,7)$$

$$F(a,b,c) = \prod(1,4,6)$$



- b- Implement the same function F with 2-to-4 decoders and an OR gate.

$$F(a,b,c) = \sum m(0,2,3,5,7)$$



Question [4] : [16 marks]

A ROM is used to store the values of the word Y . Where Y is equal to:
 $Y = X^2$ X is a 3-bit number.

a- Give the ROM size in bits.

b- Draw the ROM structure by showing only the last line of the matrix array.

a)

$$Y_{\max} = (7^2)_{10} = (49)_{10}$$

$$X_{\max} = (111)_2 = (7)_{10}$$

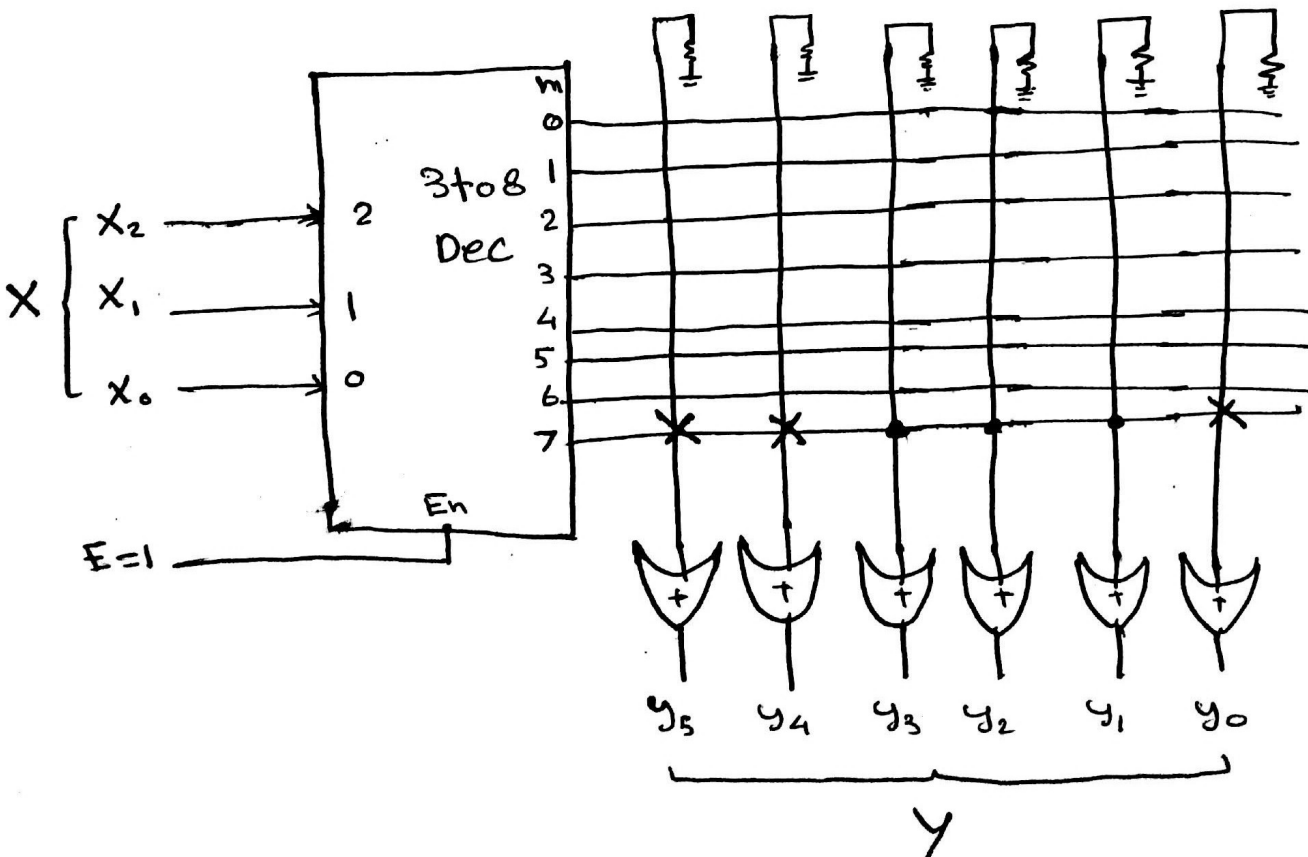
$$(49)_{10} = (110001)_2$$

$$32 + 16 = 48$$

$$n = 3$$

$$m = 6$$

$$\text{ROM size} = 2^3 \times 6 = 8 \times 6 \Rightarrow 8 \text{ words} \times 6 \text{ bits}$$



Question [5] : [16 marks]

Complete the following timing diagram for a J-K flip-flop shown in the figure. Label the different states of Q as one of the following (Set, Reset, PreN, ClrN, no Q change, Q change). Assume initial value $Q=0$.

